

Three Way Multi Model Interoperation

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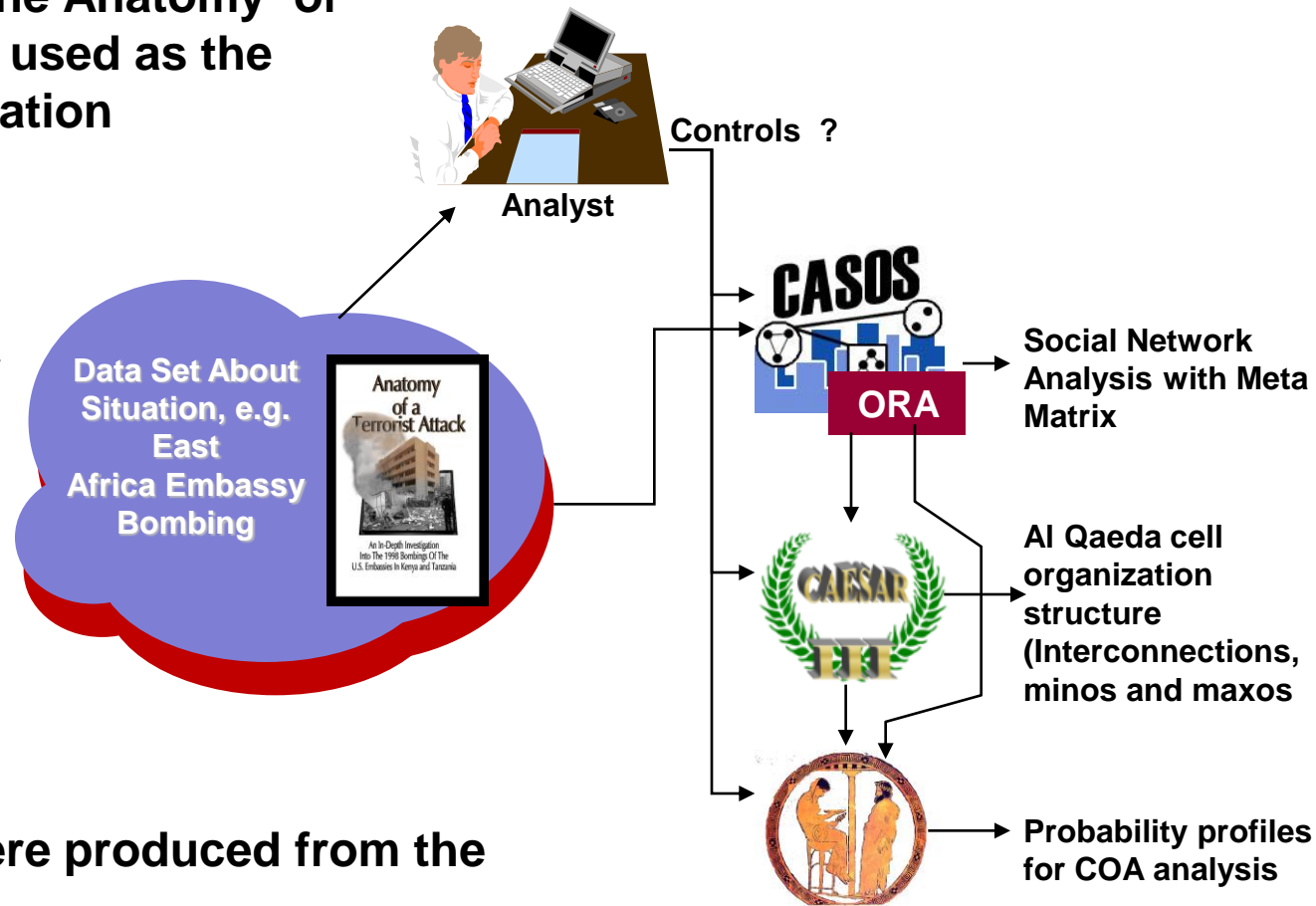
Adversary Behavioral Modeling
Maxwell AFB, Montgomery AL
March 18 - 19, 2008

- A process and interoperation technique for using three modeling tools (ORA, CASEAR III, and Pythia) has been demonstrated using the East Africa Embassy Bombing (1998) as an example
- Outline
 - Approach
 - Models
 - Results

Approach

- With respect to the suite of models available from CASOS, CSC, and SAL the question of how data or information can be passed between the models is unknown or un-proven.
- A Limited Discovery Experiment was used to explore the potential interoperation between modeling techniques to determine if:
 - 1) interoperation is possible,
 - 2) various interoperation types can be applied
 - 3) use of such interoperation would improve the overall analysis over that provided by the models independently.
- A case study approach was taken using a corpus of data about the al Qaeda Bombings of the Embassy in Kenya.

- A single data source, the Anatomy of a Terrorist Attack, was used as the input for the Demonstration
- The information in the document was fed into the CASOS tool via Automap and edited by the analysts who used read the data set
- Outputs from ORA were used to create CAESAR III and Pythia models
- Analytical products were produced from the three tools

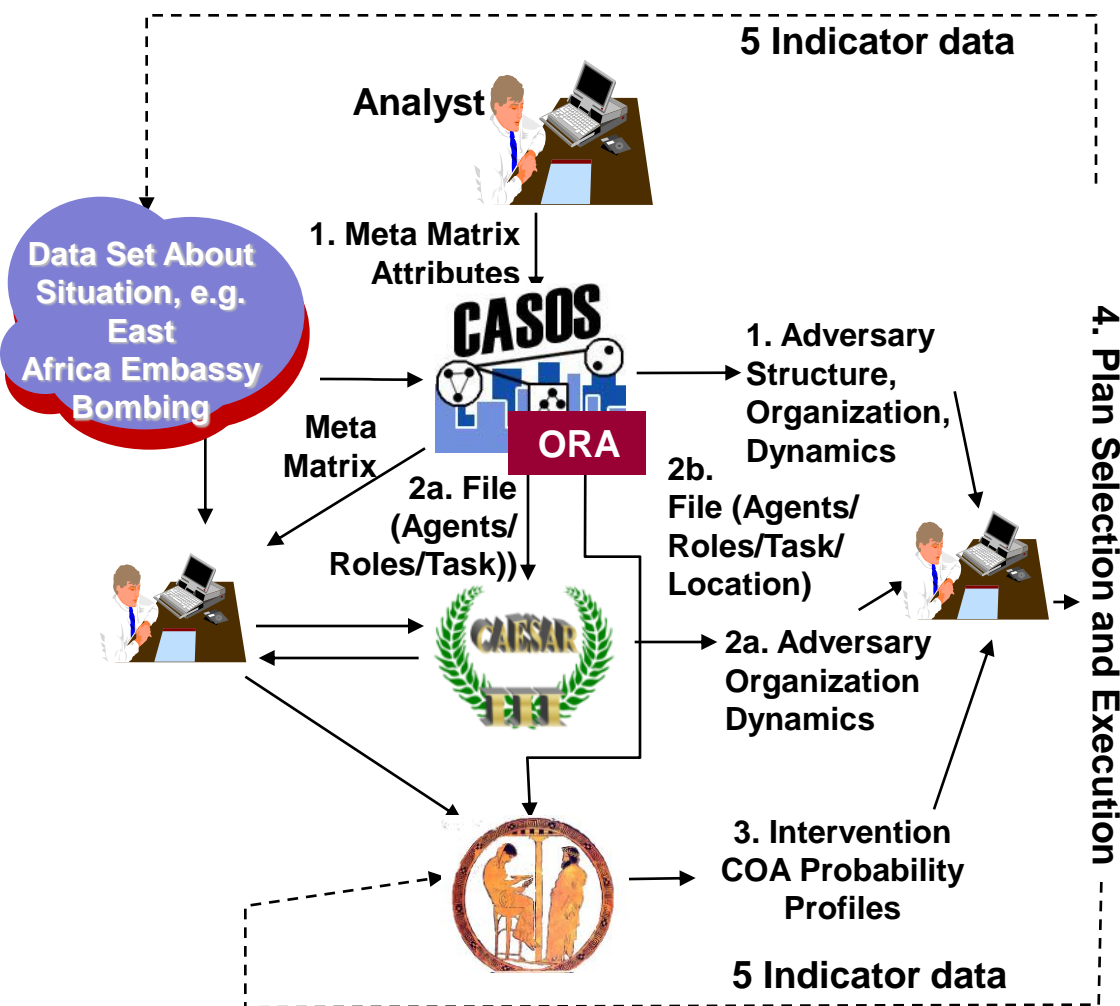


Types of Interoperation



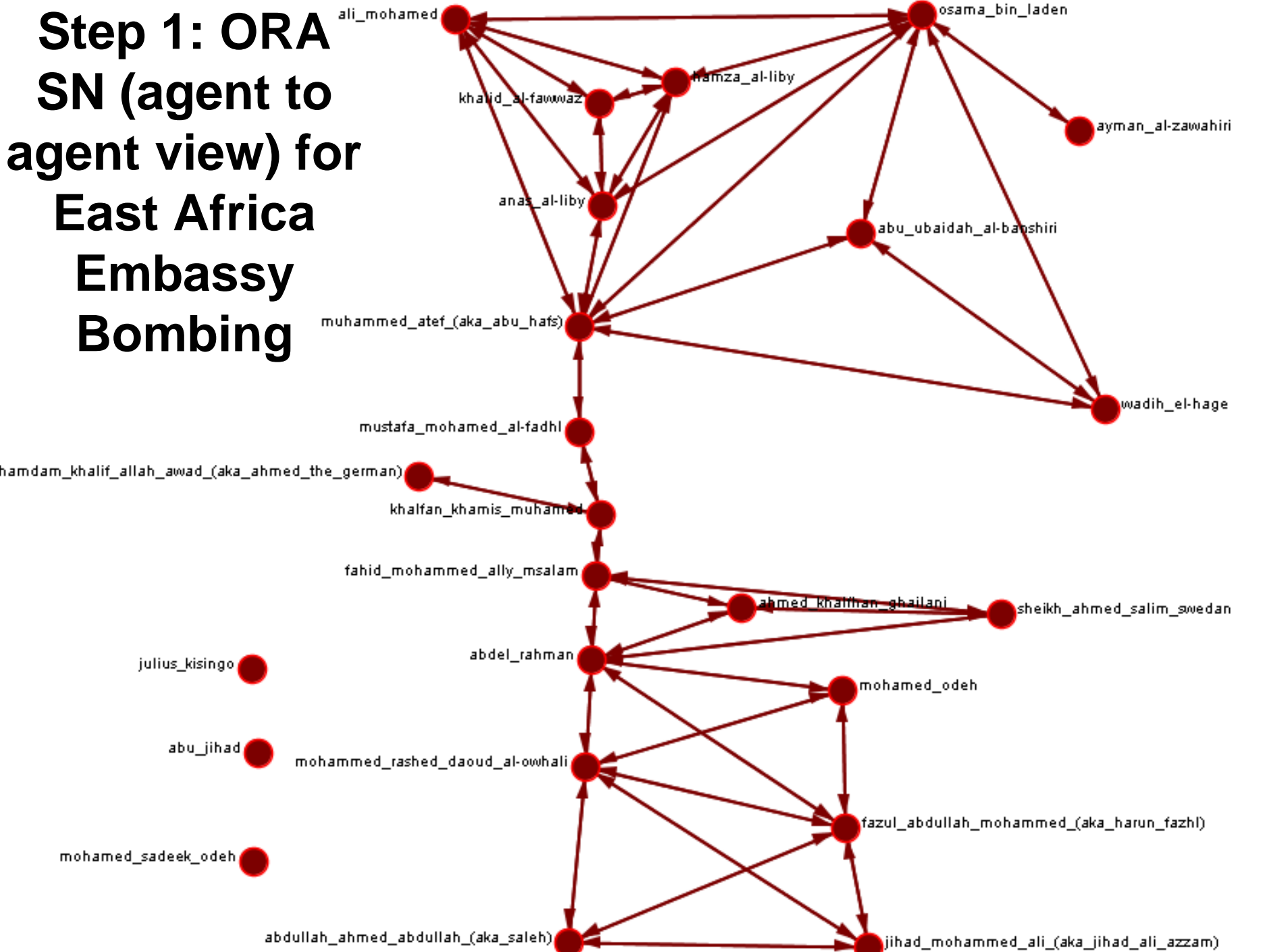
- The basic proposition: Understanding of an adversary and analysis of Effects based Courses of Action can be improved by using these multiple models by exchanging information or data between them.
- Three types of interoperation have been postulated
 - Human to human (Swivel Chair) (Human gains insights from model 1 that helps with the human set up or analysis of model 2)
 - Data to Data (files can be exported from one model that can be “read” automatically by another model under the direction of the analyst)
 - Automated Model to Model (Model can be connected over a network and automatically exchange data as they are “run”)

Experiment (Interoperation) Process Example

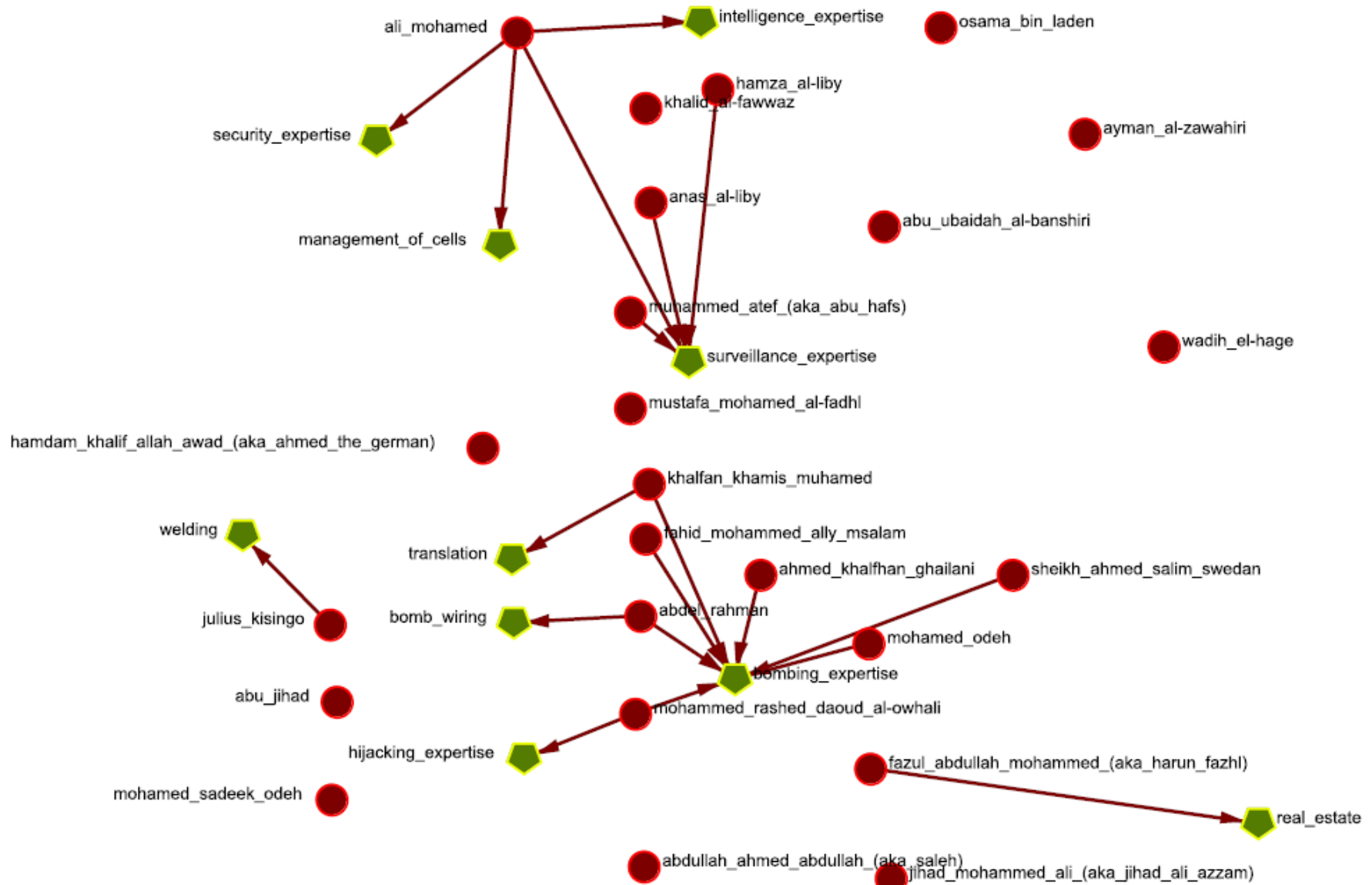


1. Analyst sets up **Automap** and Runs **ORA** generating **Meta Matrix** and **XML File** for CAESAR 3 and Pythia
- 2a. **CAESAR III** analyst uses ORA file plus knowledge from Data Set to **generate adversary organization models** (lattice plus CP net). Identifies potential communications links for ISR
- 2b. The analyst loads ORA file into **Pythia** and refines the model using ORA Meta Matrix in Pythia
3. Analyst uses TIN to produce probability profiles, **comparing COAs for selection.**
4. COA is selected, planned, and executed including ISR Tasking
5. Indicator data from ISR used to update Data Set and Pythia for on-going Assessment

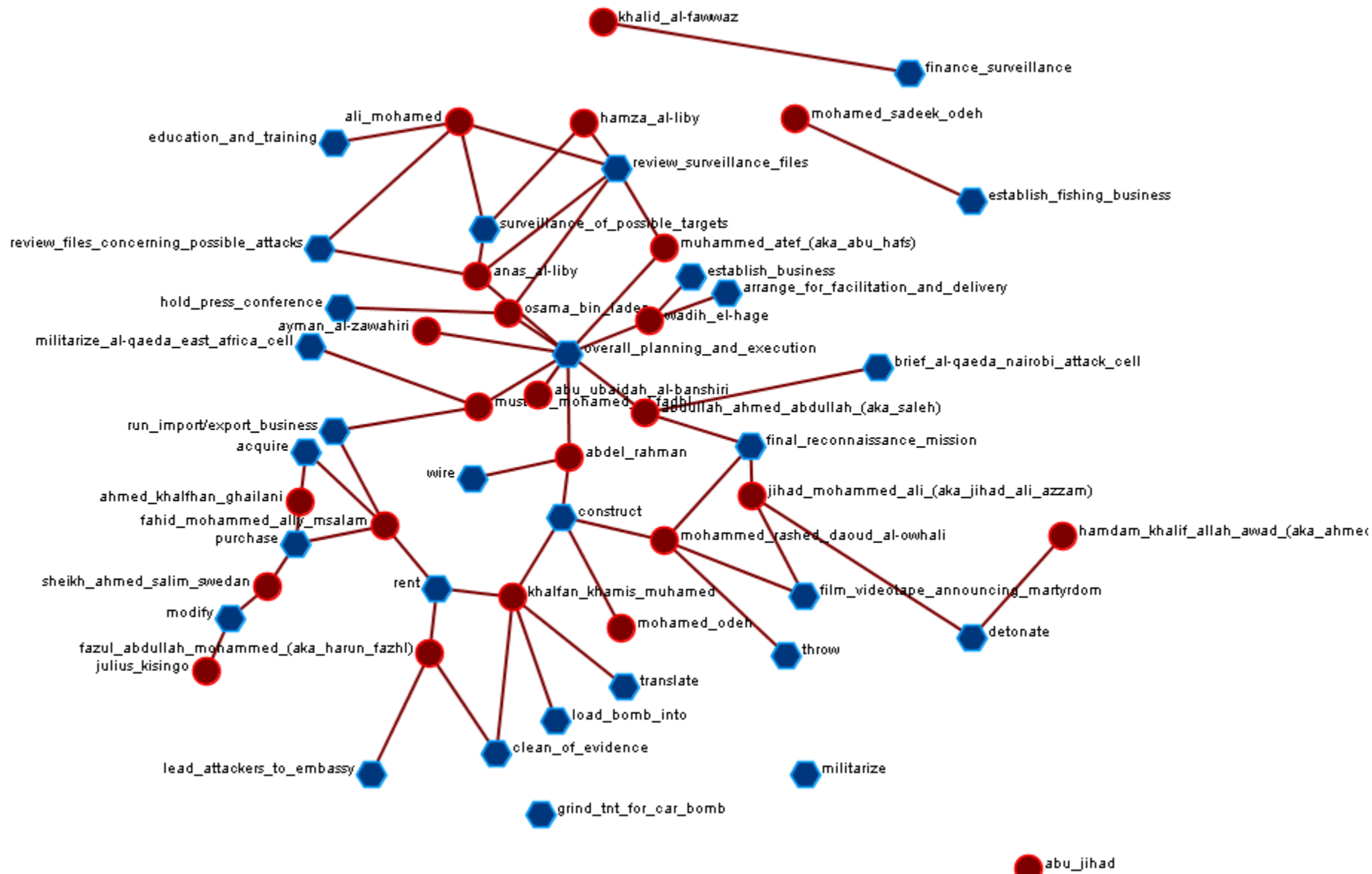
Step 1: ORA SN (agent to agent view) for East Africa Embassy Bombing



ORA Agents to Knowledge



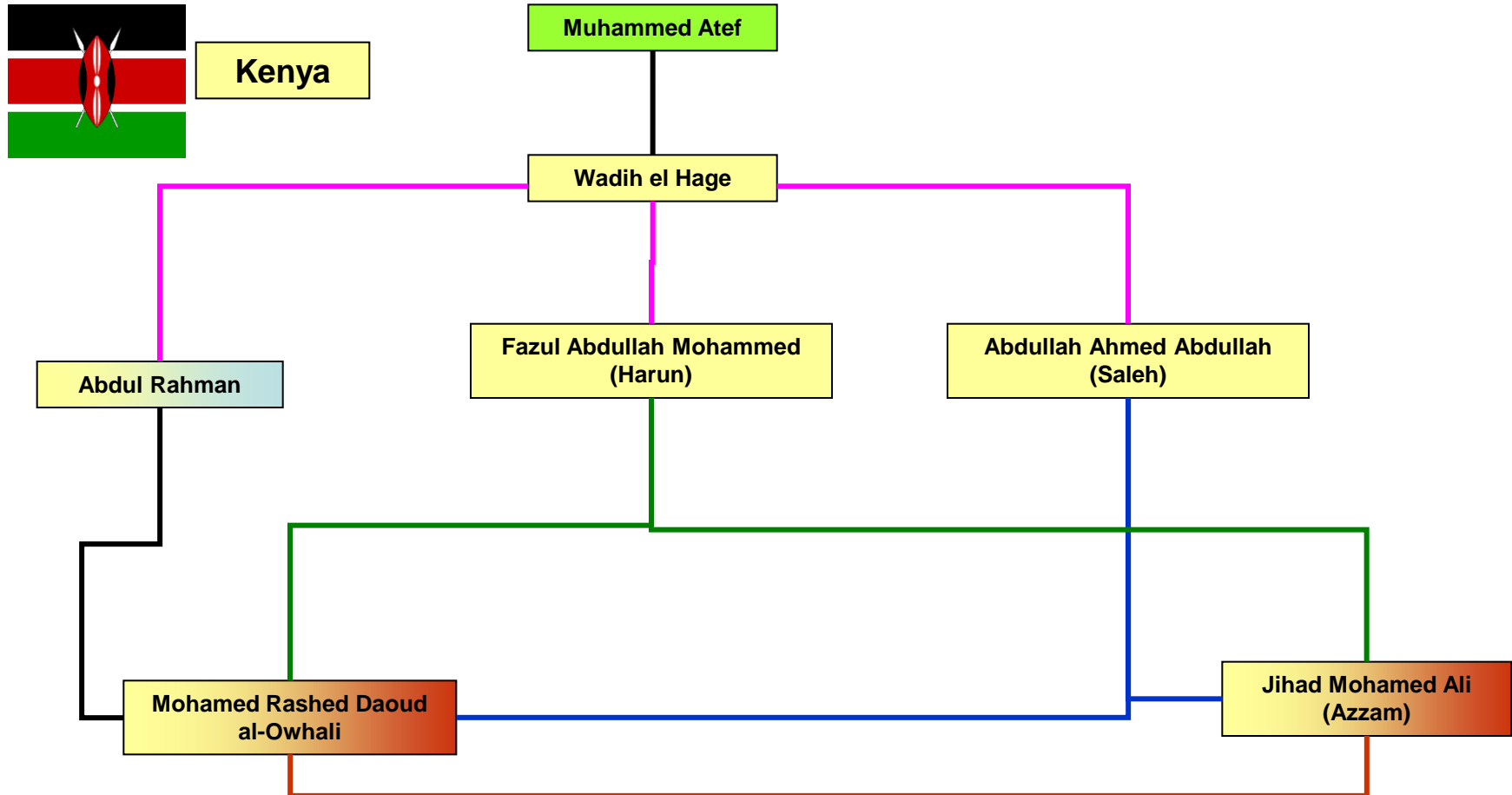
Step 1: ORA SN (agent to Task view) for East Africa Embassy Bombing



The Kenya Team



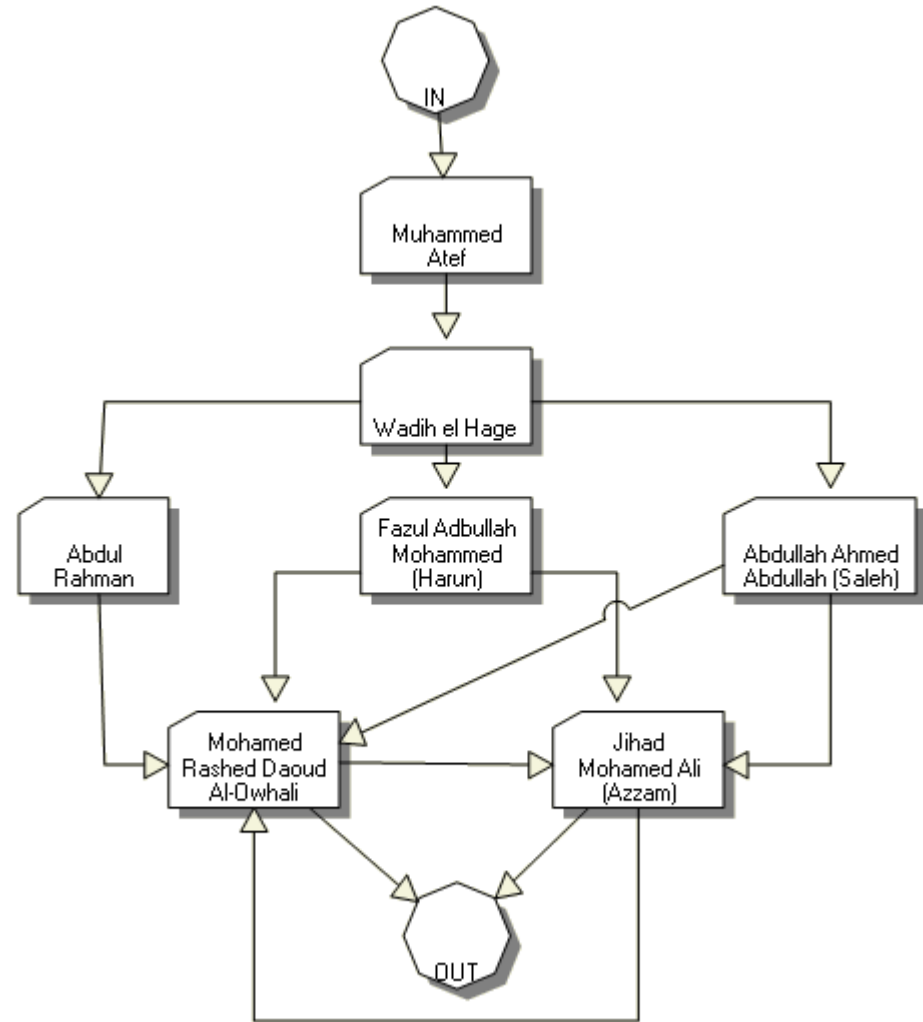
The following command structure was inferred from reports (text) and ORA meta matrix



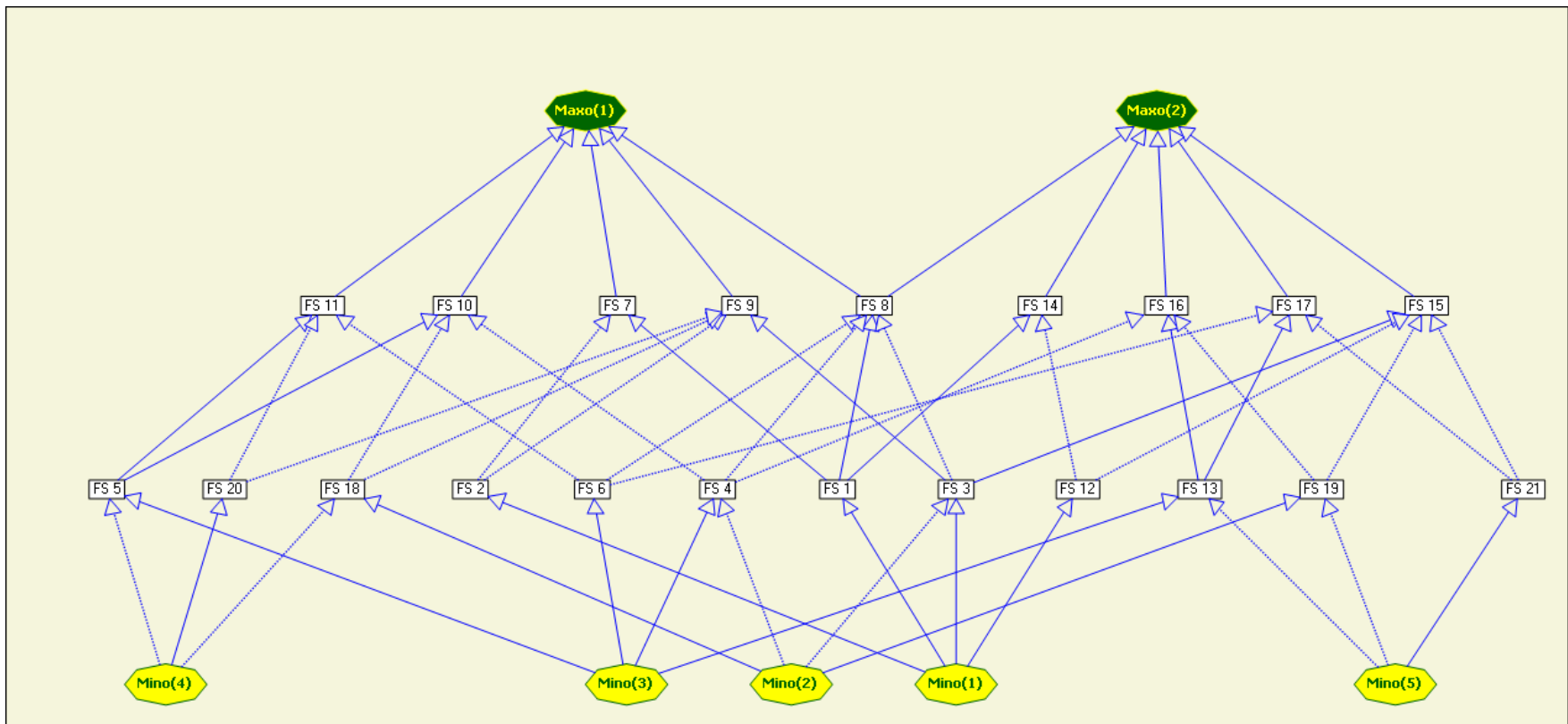
The Kenya Team



- The same representation in CAESAR III



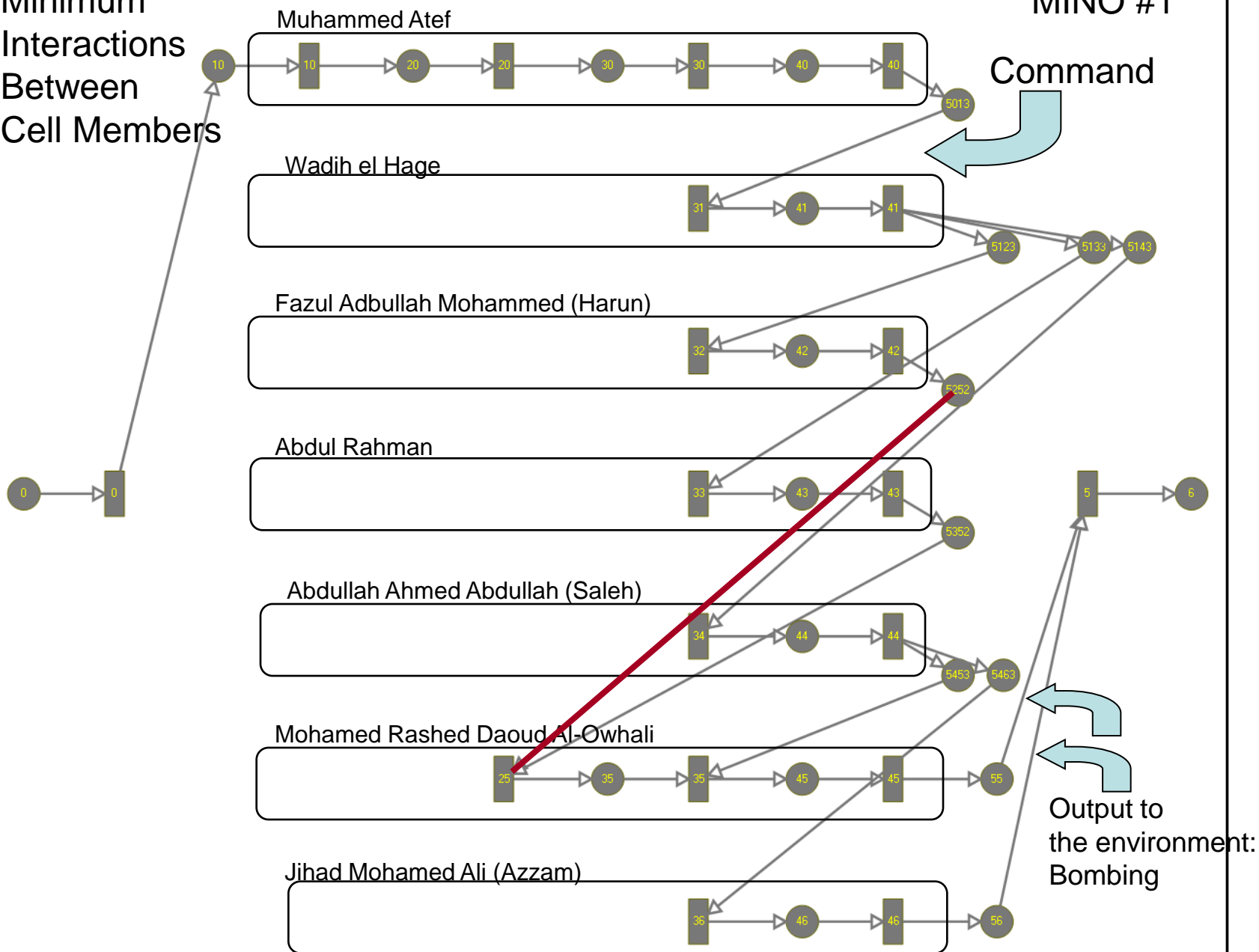
- Lattice Algorithm reveals all possible organizational structures (28) of the Al Qaeda Kenya cell



Minimum
Interactions
Between
Cell Members

MINO #1

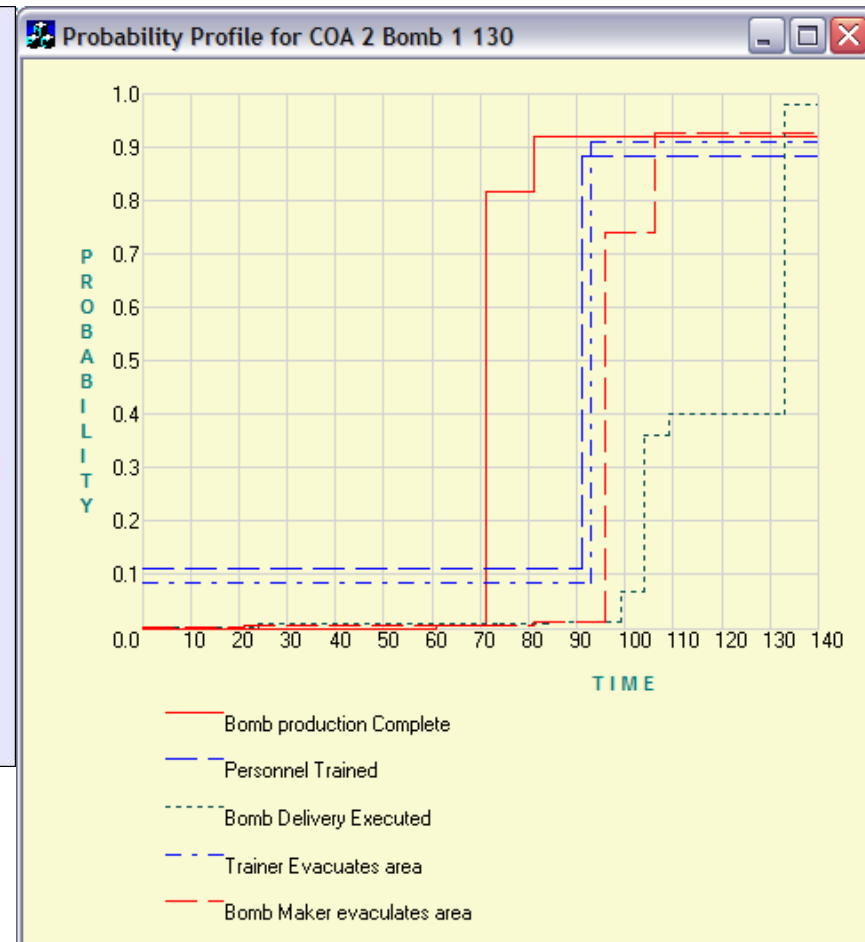
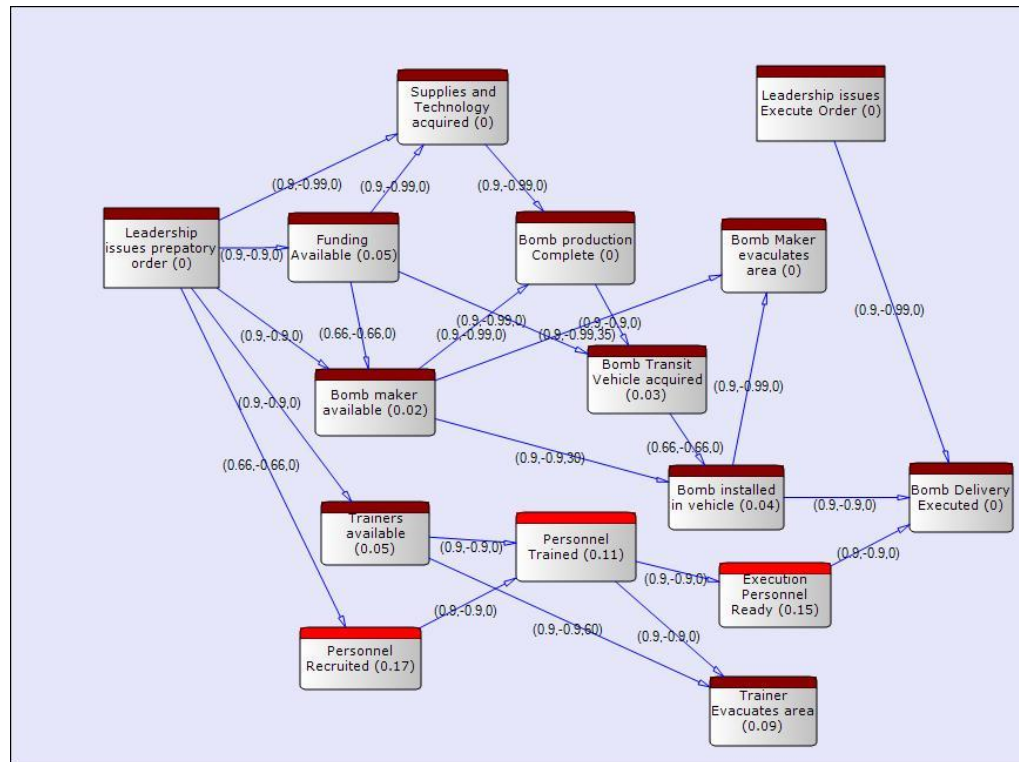
Command



Adversary Model of Plan (Based On SNA of Kenya Attack)

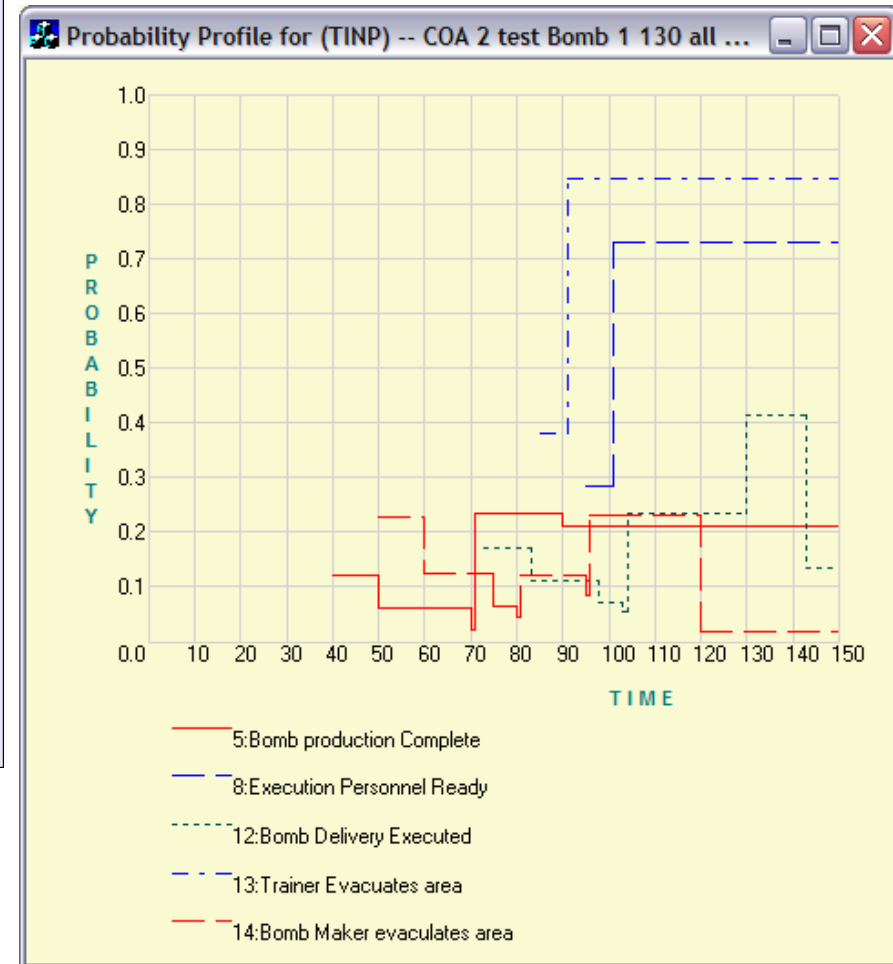
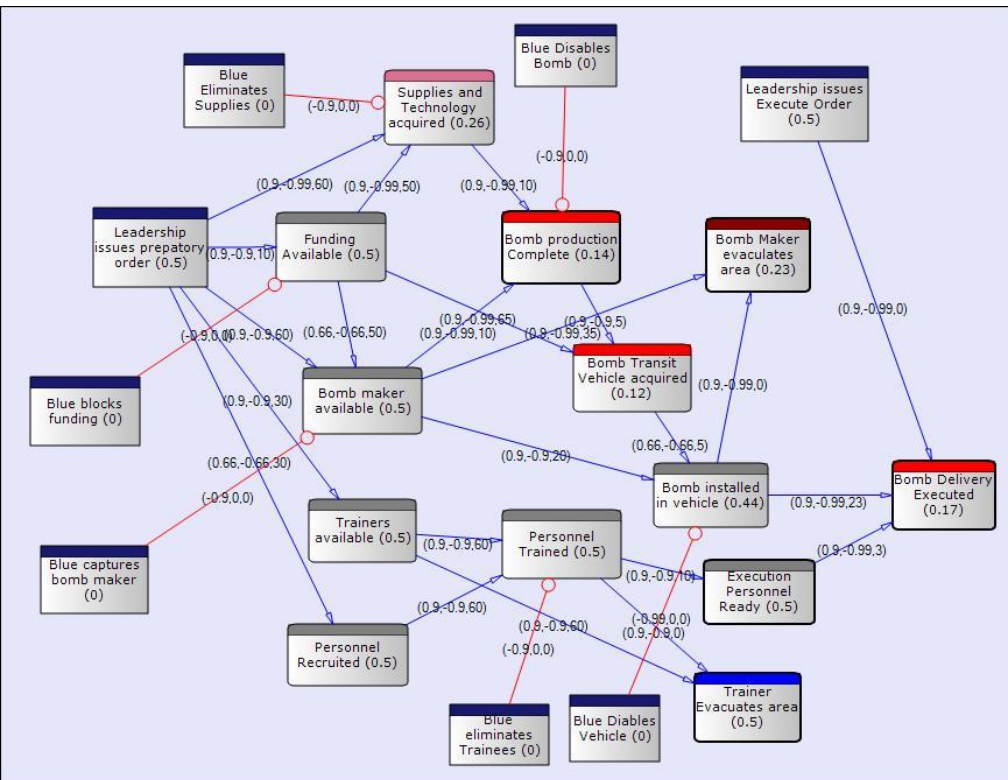


Model was created using Human to Human interoperation

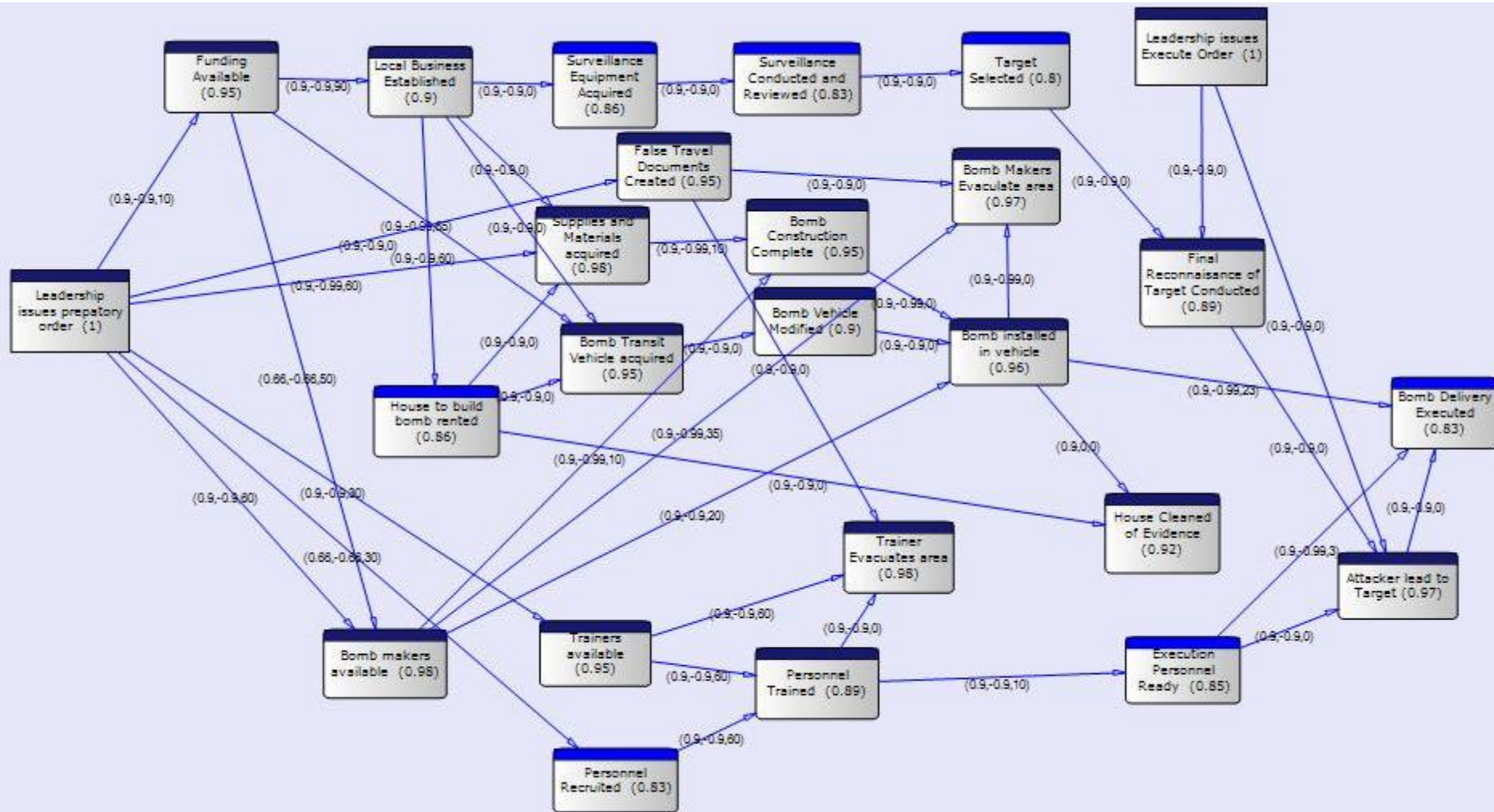


- Derived from events and their timing as described in “Anatomy”
- The actors and their roles from the SNA and CAESAR 3 map to the events
- h and g values assigned based on understanding of TIN

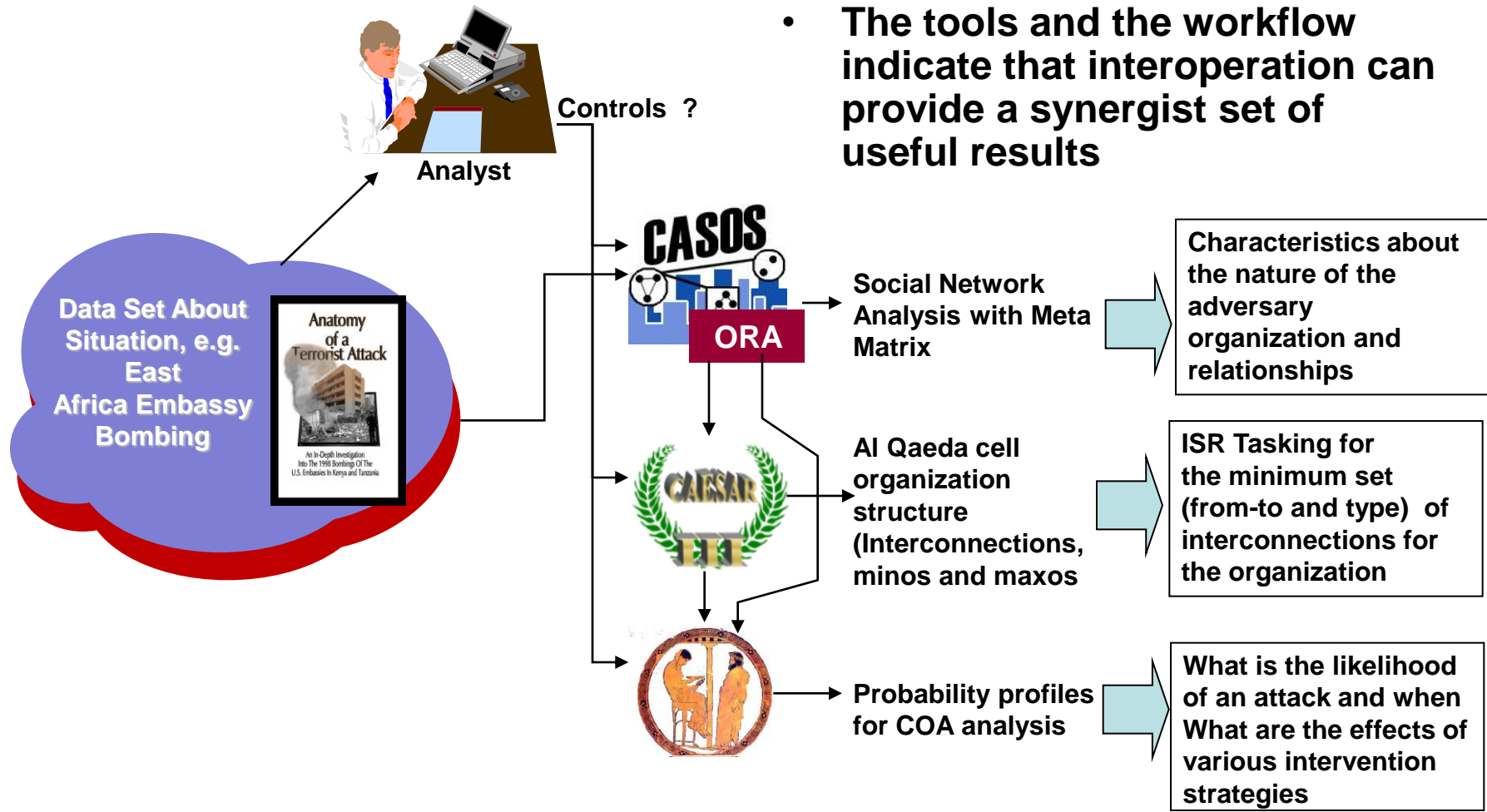
Adversary Model of Plan w/Blue Interventions



- Hypothetical Blue actions (as might be perceived by the adversary) added



Demonstrate Potential



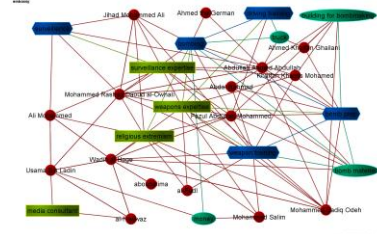
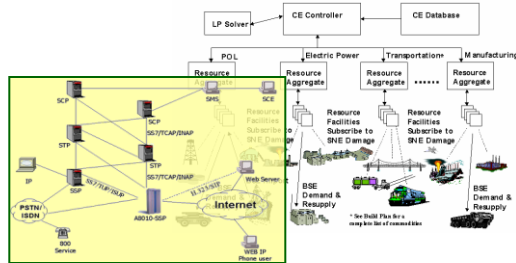
- **Given**
 - **Multiple Knowledge Representations**
 - **Multiple Reasoning/Computational Approaches**
 - **Modeling/Analysis Objective**
 - A set of questions to be answered by the analyses performed on the computational models
- **Solution**
 - **Identification of Model(s) and/or Combinations of Models that offer insight into the solution space**
 - **Workflow**

- **Nexus Between Models**
 - What *query* can be generated in one model that can be answered by the other?
 - What are the *overlaps* among the models?
 - How do we determine if the output of one is *supported* by the output of the other?
 - How do we identify *gaps*, *inconsistencies*, or *incompleteness* (need for more information)?
 - ...
- **Workflow**
 - Given an analysis objective, what is the workflow (i.e., combination, interactions, and sequence of/between models) that exploits the multi-modeling nexus in addressing the objective?

Setup – Model View

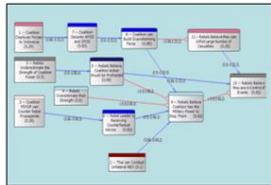


Engineering System Models
E.g., Networks, CEM

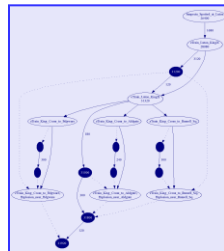


Social Network Models

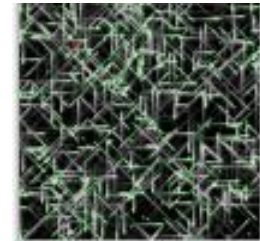
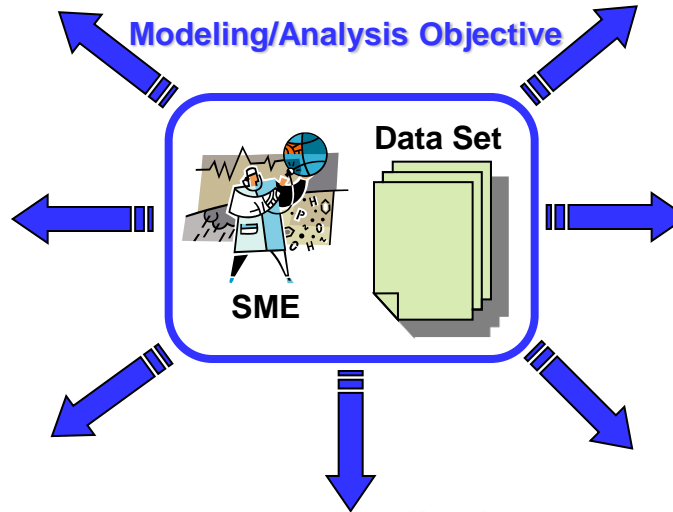
Situational Influence Models
E.g., Timed Influence Net



Temporal Models



Modeling/Analysis Objective

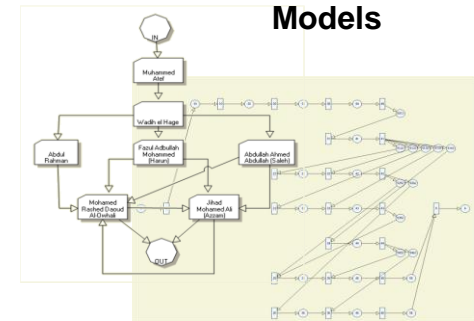


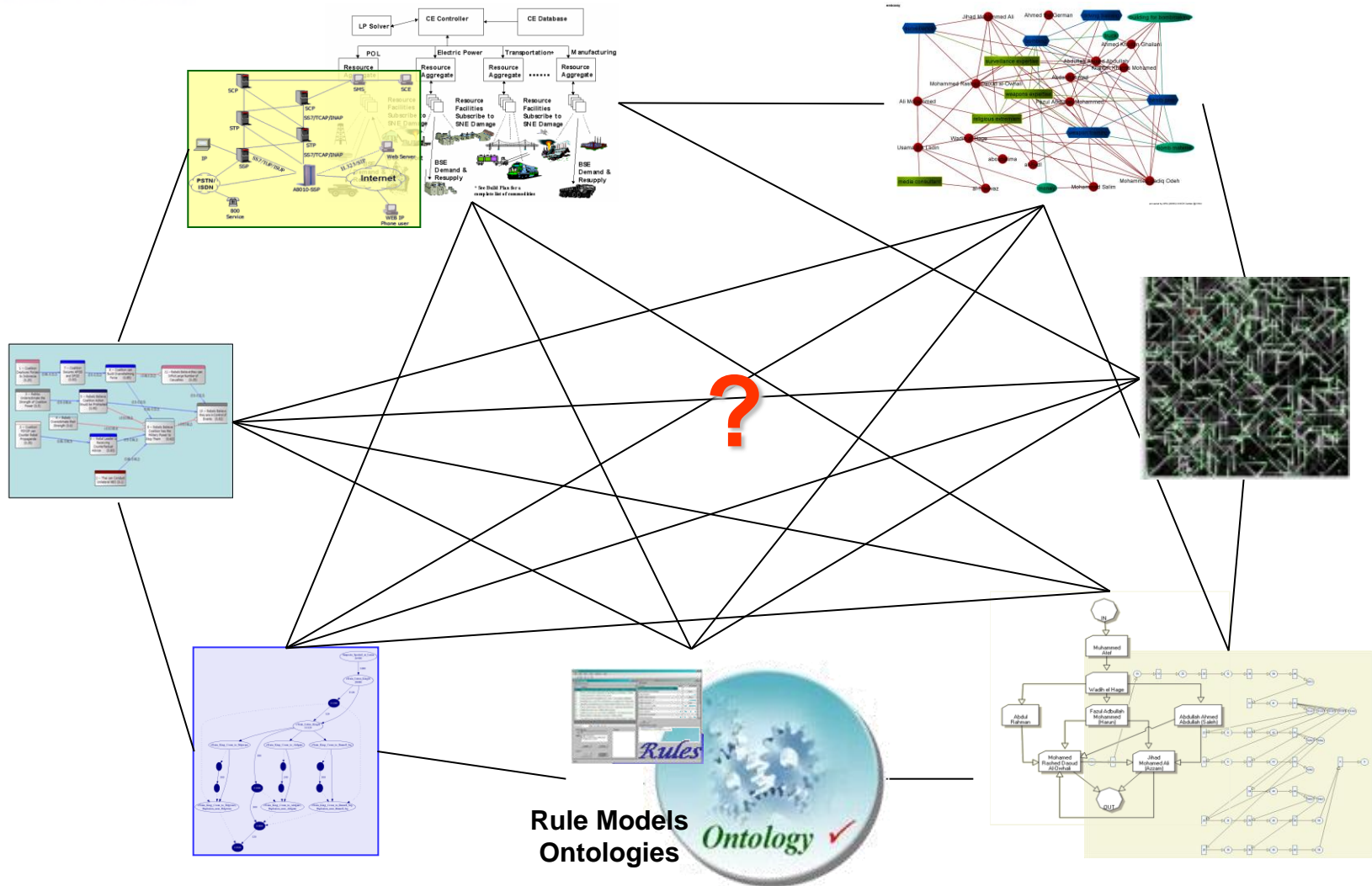
Multi-Agent Simulation Models

Rule Models Ontologies



Organization Models





- Better Model Construction by:
 - Providing design parameters for the construction
 - e.g., Social Network to Organization structure.
 - Providing the structure (partially and/or completely)
 - e.g., Social Network to Timed Influence Net.
- Model Validation
 - Results from two models support each other
 - Multi-agent model and Social Network simulation models.
- Enhancements to analysis capabilities of a model by employing functionality from another
 - e.g., Temporal analysis of Timed Influence Net modes.
- Construction of new models by embedding multiple models in a single framework
 - e.g., Organization and Communication models.

- **Three way interoperation between models has been demonstrated**
 - **One tool and its model can assist in the creation of a different model in another tool**
- **Used a combination of human “swivel chair” and data-to-data interoperation**
- **Process workflows are being developed.**
- **More effort needed to refine workflows and interoperation techniques**
- **Need to extend the approach to more models**